Reducing Error Rates Using IT and the Role of the Internet

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Goals

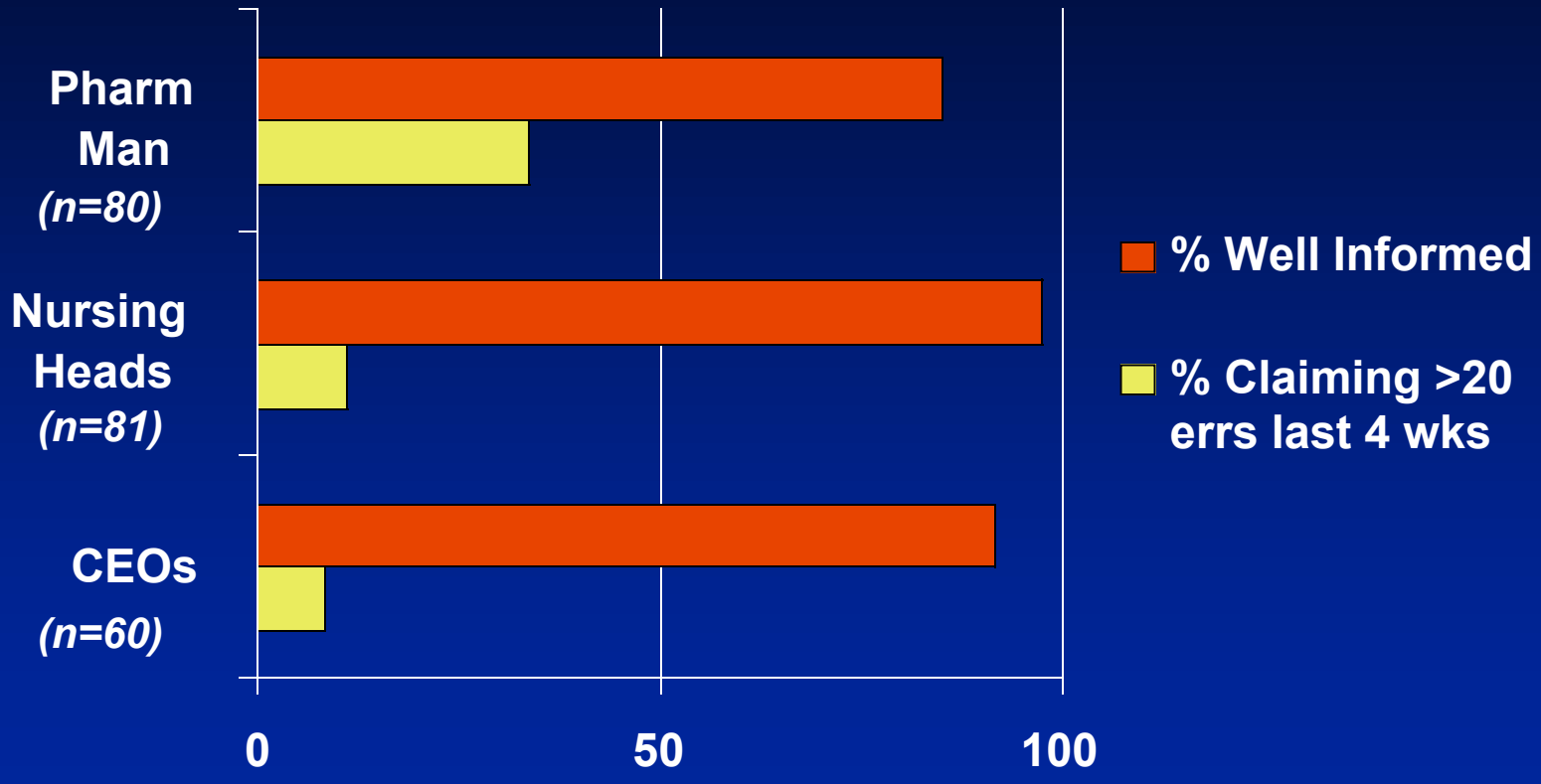
- Iatrogenic injury background
- Theory relating to POE
  - Implementing POE
- Medication safety
  - Epidemiology of ADEs and medication errors
  - Medication error prevention
  - Reducing drug costs
- Overarching lessons learned

The IOM Report

- Report targets hospital errors: Mistakes killing thousands every year *11/30/99*
  - Medical errors kill 44,000-98,000 people per year
  - "More people die from medical errors each year than from suicides, highway accidents, breast cancer, or AIDS"
- "These stunningly high rates of medical errors - resulting in deaths, permanent disability, and unnecessary suffering - are simply unacceptable in a system that promises to first 'do no harm.'"

William Richardson

Administration's Awareness of Medication Errors



Source: Brusking Goldring Res, 1999 sponsored by BD.id

Reengineering Medicine: The Role of IS

- Could be changed by providing external aids
  - Linking medical knowledge and patient-specific data
  - Identifying options
- Without such tools, experts
  - Overlook available knowledge
  - Don’t sufficiently account for uniqueness
- Modern information tools could
  - Improve information access to experts
  - Allow patients to more effectively participate in decision-making

Weed LL, Weed L, *Federation Bulletin*, 1994

Principles of Changing Physician Behavior

- Changing behavior is hard
- Education and feedback are most likely to succeed
- Feedback is most likely to influence decision-making if it is delivered as closely as possible to the time of the decision;
  - Ideal to deliver *at the time the decision is being made*

Advantages of Computerized Guidelines

- Facilitate memory, always findable
- Immediately generalizable to all patients, providers
- Possible to point providers to them
- Facilitates central control
- Allows measurement of outcomes
  - Whether people use
    - If not, why
  - Patient outcomes
- Easy to get feedback to developers, allows iterative refinement

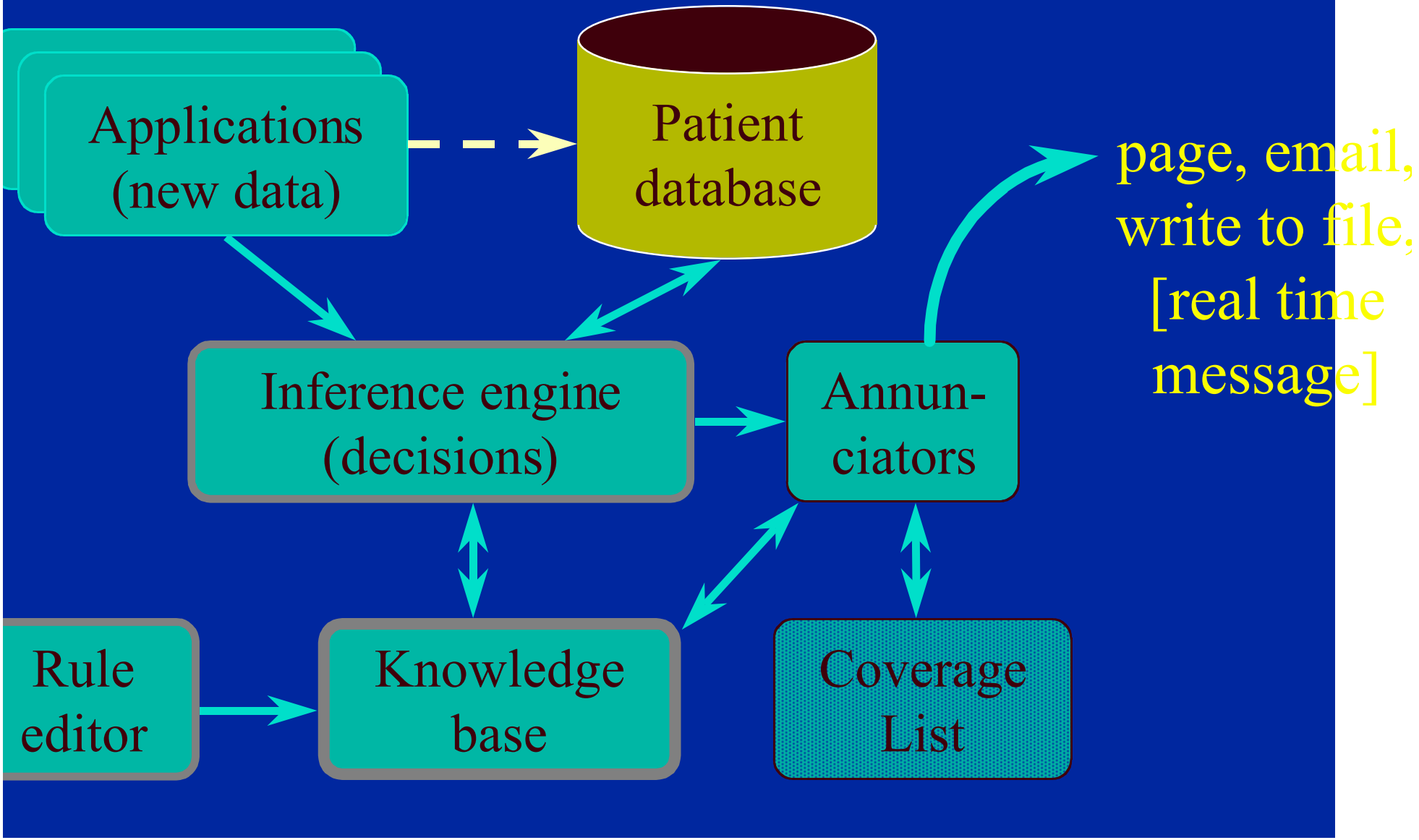
Why Use the Internet?

- Provides a single common platform
  - Standards have been a bugaboo
- Wide dispersion, remote sites easy
- Thin client is attractive
  - Most developers now building new applications using Web front end

Development and Implementation of POE at BWH: Key Success Factors

- Physician involvement and leadership
- Decision to automate existing systems as is
- Constant focus on speed
- Strong support from hospital administration
- Willingness to be flexible, modify system

Event monitor architecture



Physician Coverage List

- Functions
  - Identifies first and second-call physicians
  - Manages physician rotation
  - Handles evening coverage and signing out
- Facilitates delivery of computer-generated messages
  - Computer-page interface allows automated paging

Do We Have the Systems We Need in Place? Results of a National Pharmacy Computer System Field Test of Unsafe Orders

	Unsafe order not detected
1. cephradine oral suspension IV	61%
2. vincristine 3 mg IV x 1 dose (2-year-old)	62%
3. colchicine 10 mg IV for one dose (adult)	66%
4. cisplatin 204 mg IV x 1 dose (26 kg child)	63%

Source: ISMP Medication Safety Alert! Feb 10, 1999

Medication Error Frequency and Potential for Harm

In 10,070 Orders

530 Medication Errors — 1.4 per admission

35 Potential ADEs

5 Preventable ADEs

- 1 in 100 medication errors results in an ADE
- 7 in 100 represent potential ADEs

Bates et al, J Gen Int Med, 1995

ADE Prevention Study: Key Results

- 6.5 ADEs/100 admissions
  - 28% preventable
  - 3 potential ADEs for every preventable ADE
  - 62% of errors at ordering and transcription stages

JAMA 1995;274:29-43

Costs of ADEs

- ADEs are expensive
  - $2461 per ADE, $4555 per preventable ADE
  - Annual BWH costs:
    - $5.6 million for all ADEs
    - $2.8 million for preventable ADEs
- These figures exclude costs of:
  - Injuries to patients
  - Malpractice costs
  - Costs of admissions due to ADEs
- Figures justify investment in prevention efforts

JAMA 1997;277:307-311

Implications of Systems Analysis for Error Prevention

- Improved information access
  - Computer can provide information at time needed
- Reduced reliance on memory
  - Choices from menus
- Standardization
- Error-proofing
- Training

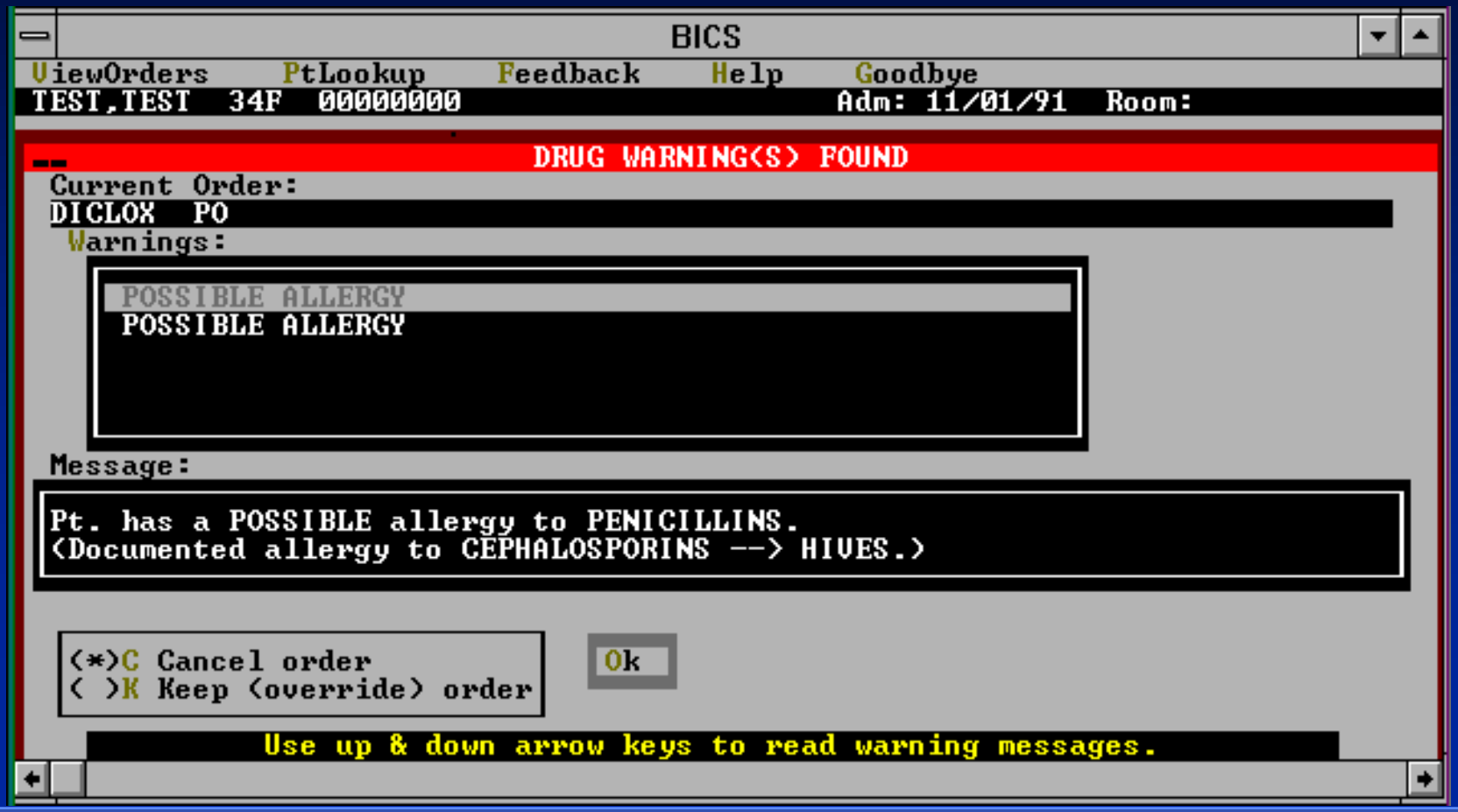
Leape et al, JAMA, 1995

Improving the Quality of Drug Ordering with Order Entry

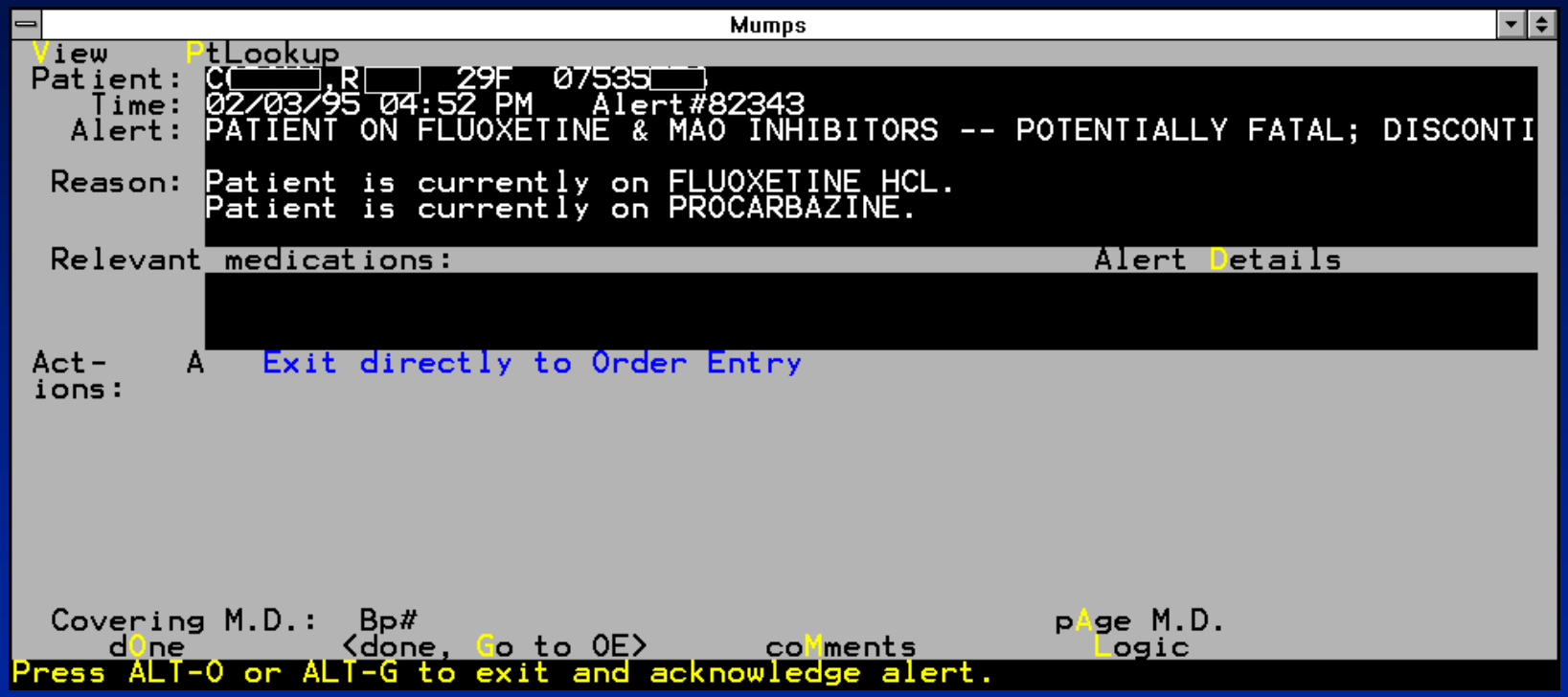
- Streamline, structure process
  - Doses from menus
  - Decreased transcription
  - Complete orders required
- Give information at the time needed
  - Show relevant laboratories
  - Guidelines
  - Guided dose algorithms
- Perform checks in background

Drug-allergy	Dose ceiling
Drug-drug	Drug-patient characteristic
Drug-laboratory	

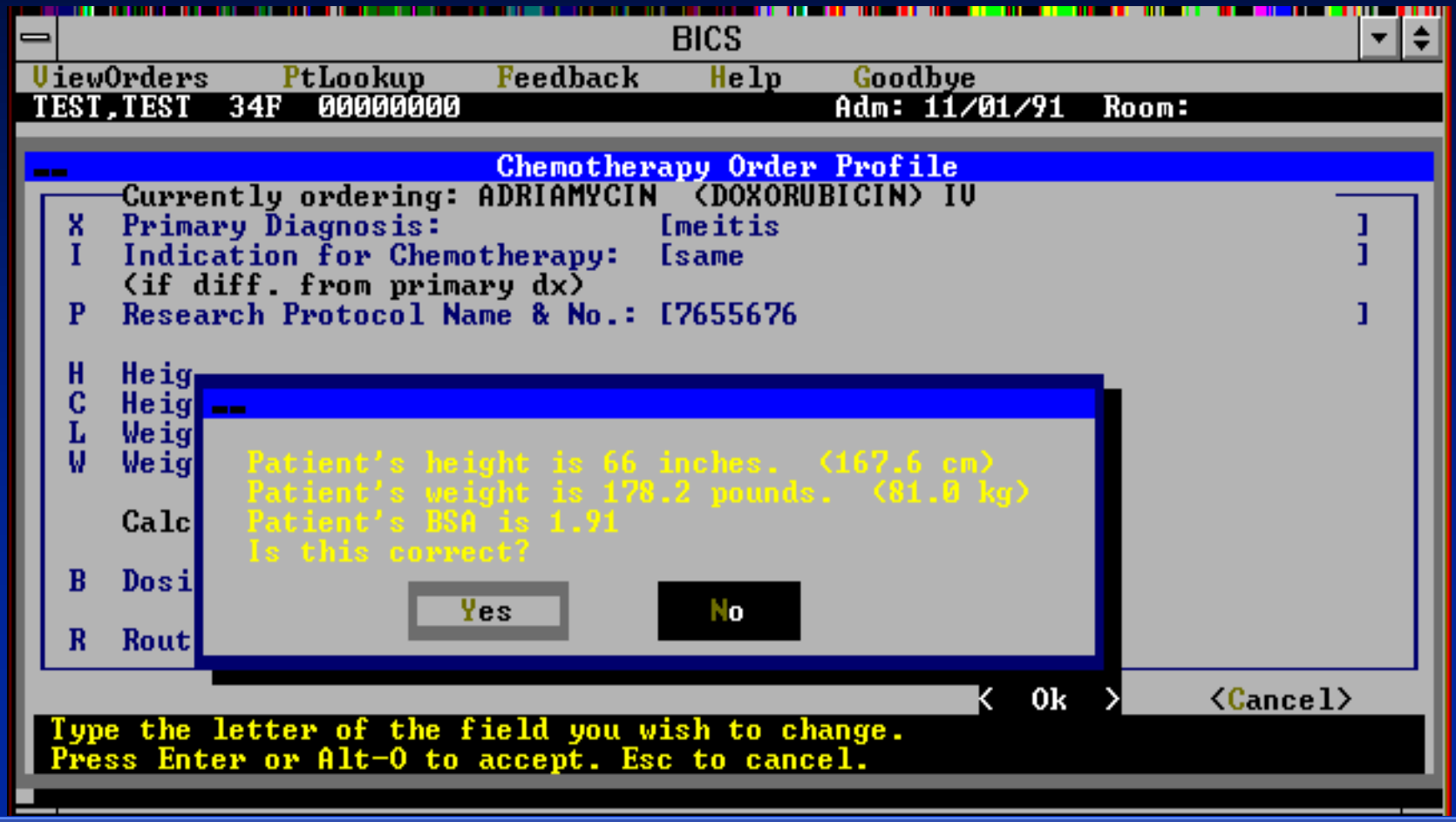
Allergy to Medication



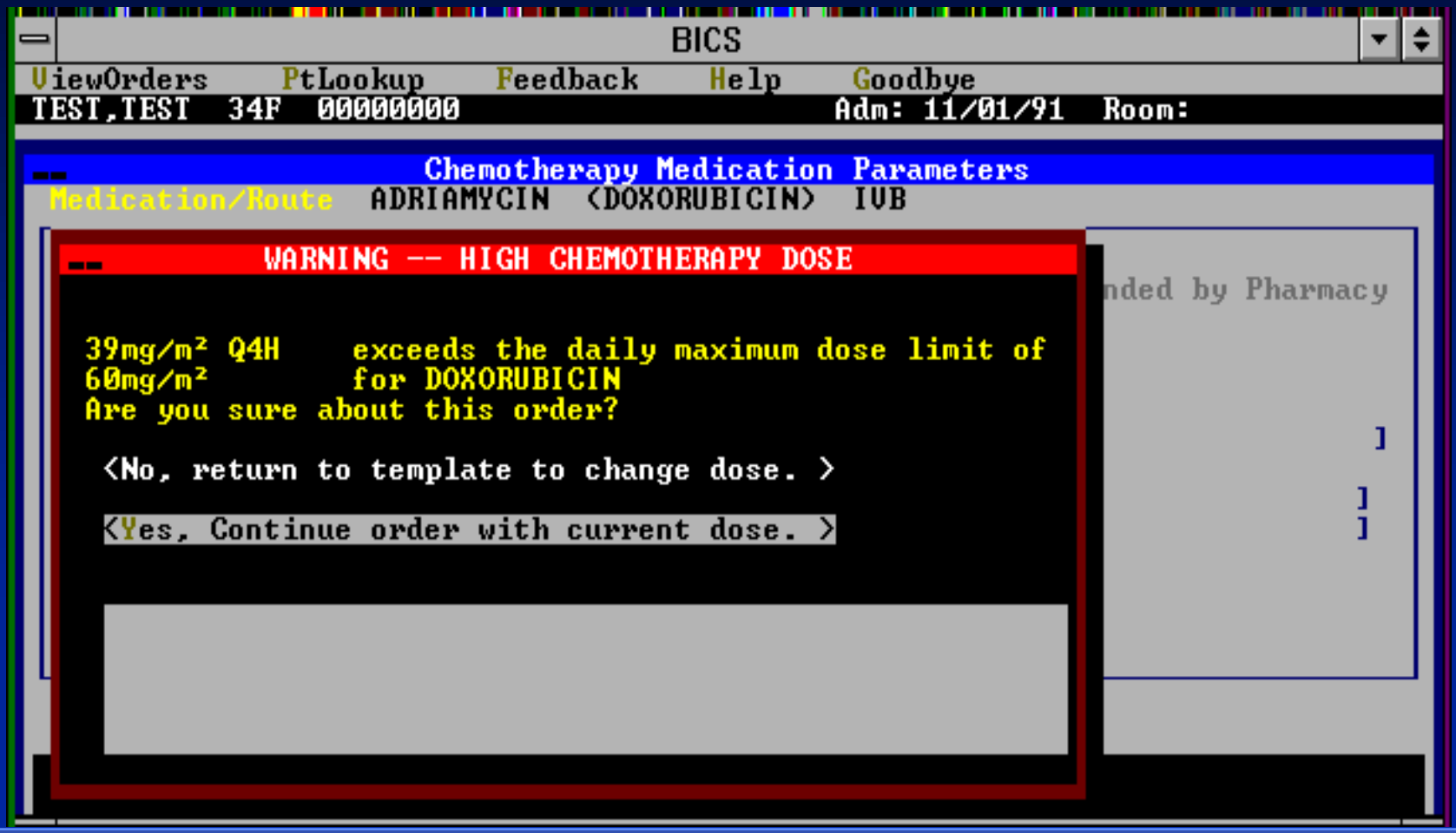
Drug-Drug Interaction Checking



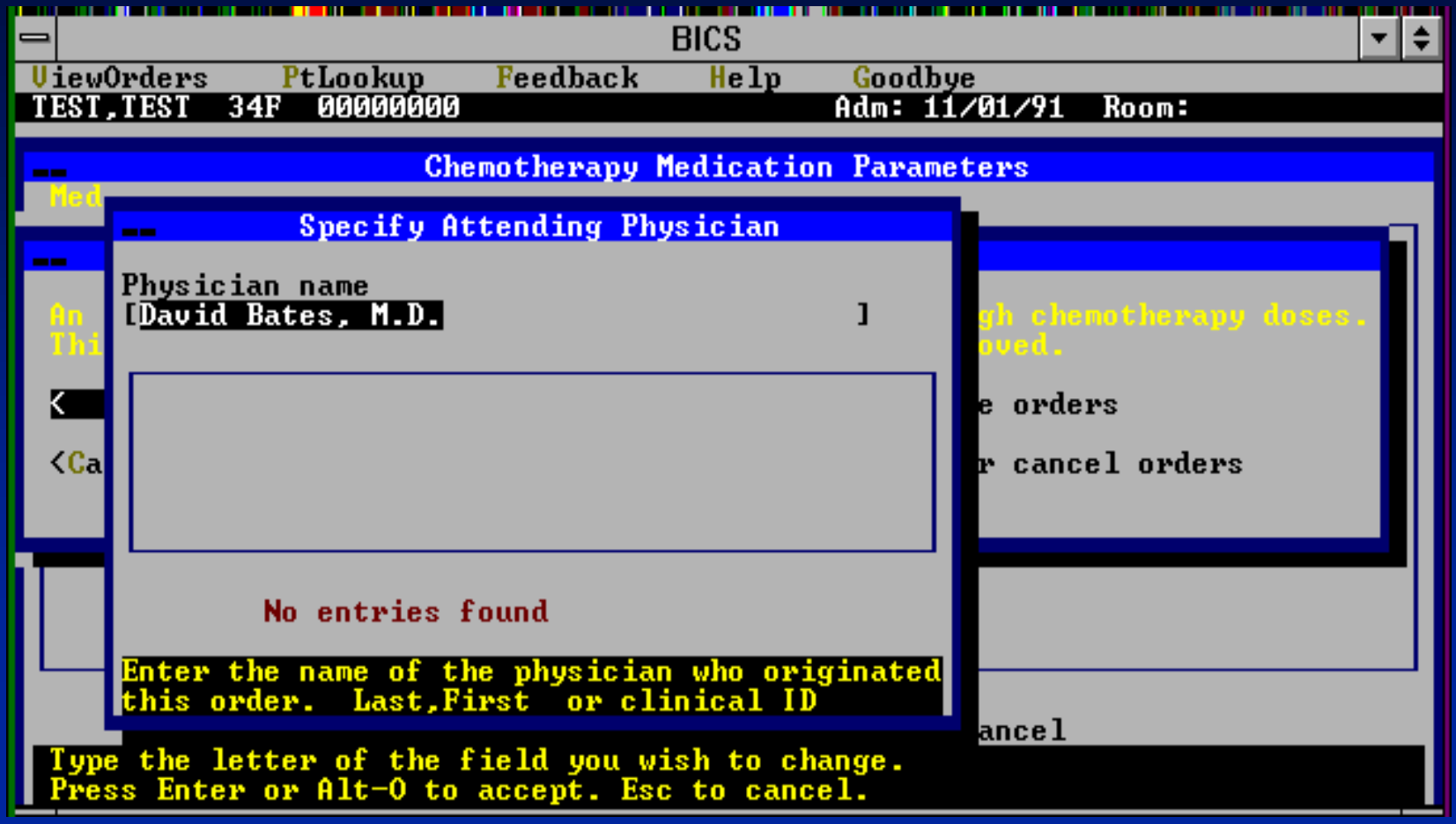
Chemotherapy Order: Patient Characteristics



High Chemotherapy Dose Warning



High Chemotherapy Dose:
Requires Attending Physician's Approval



Results of Two Studies on Medication Error Prevention

- First study uses non-missed dose medication errors as main outcome
  - Design--interrupted time series over 5 years
  - Intervention--POE at several stages of development
  - Units studied--three medical units

  Bates, *JAM IA* 1999
- Second study uses serious medication errors as main outcome
  - Design--controlled trial, using both contemporaneous and time series comparisons, over 15-month period
  - Intervention--POE at one stage, and a team intervention
  - Units studied--6-8 units

  Bates, *JAMA* 1998;280:1311-6

Systems Characteristics By Period

Baseline

- Orders written on paper
- No automated decision support

System Characteristics By Period

Period 1

- Complete orders required
- Medication name, dose and frequency selection from lists
- Relevant laboratories displayed
- Decreased transcription
- Rudimentary drug-allergy checking
- Redundant medication checking
- Rudimentary drug-drug interaction checking
- Notification for several drug-laboratory problems
- Many orders entered using preapproved order sets

Systems Characteristics By Period

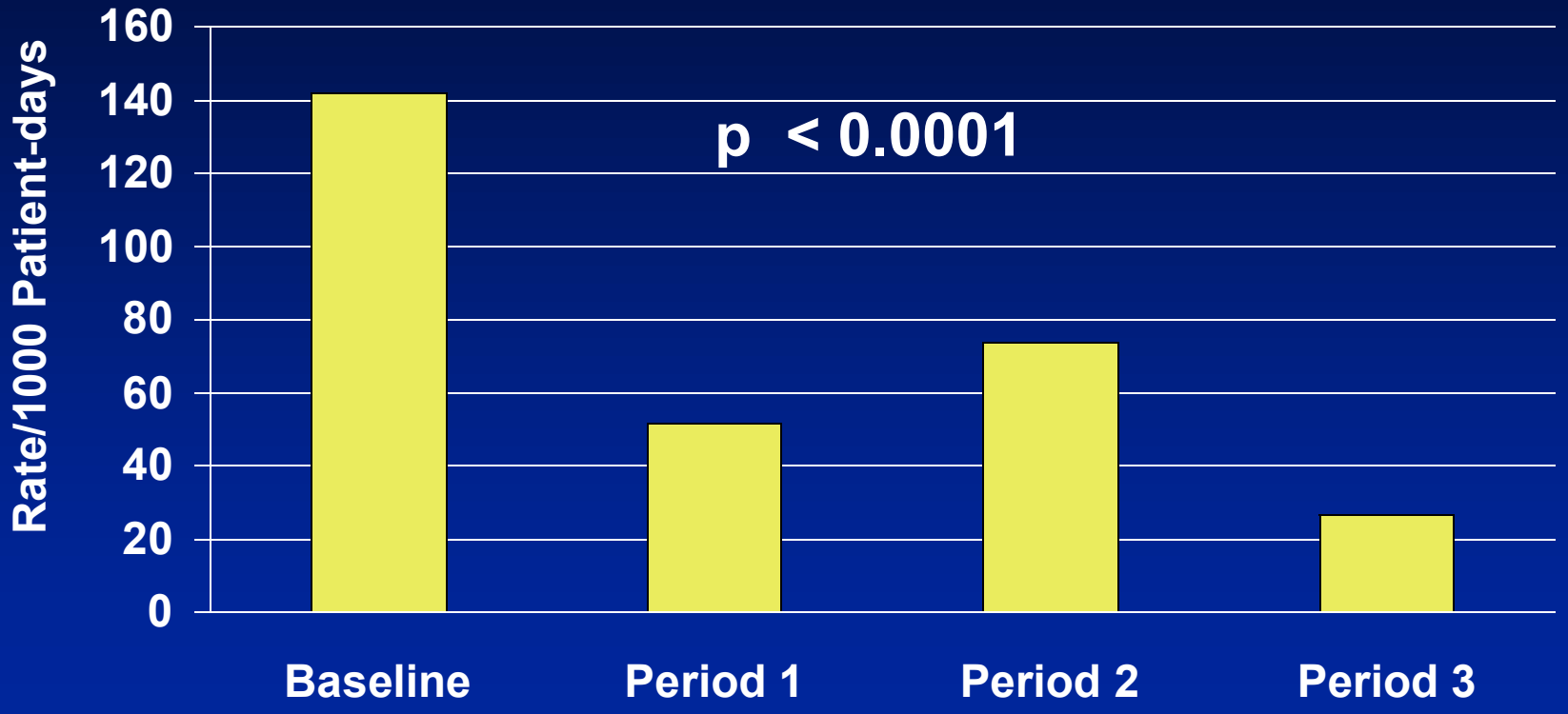
Period 2

- Improved drug allergy checking

Period 3

- Improved potassium ordering
- Improved drug-drug interaction checking

Non-Missing Dose Medication Error Rate



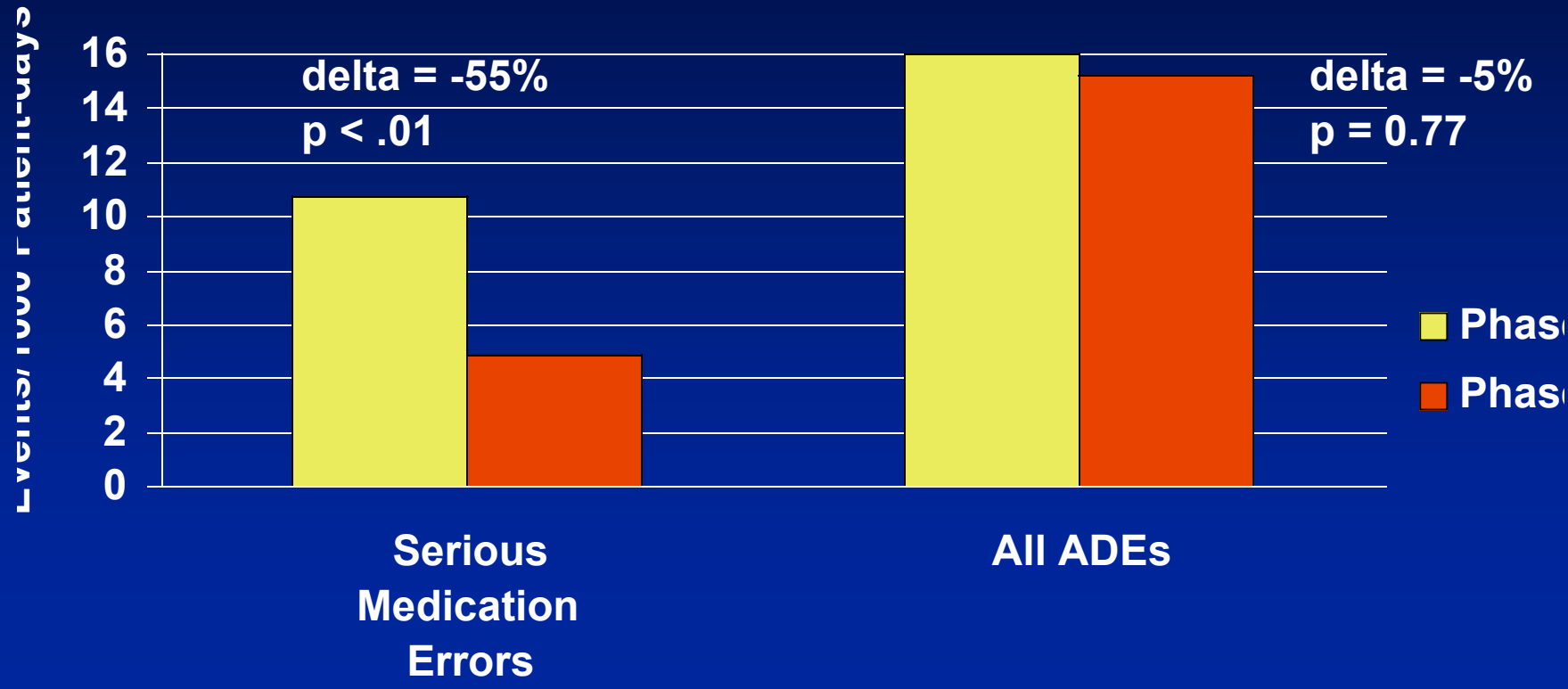
Study Conclusions

- Non-missed dose medication error rate fell 81%
  - Serious medication error rate fell 86% from beginning of study to end
- Three quarters of reduction in medication error rate was achieved with a relatively simple system

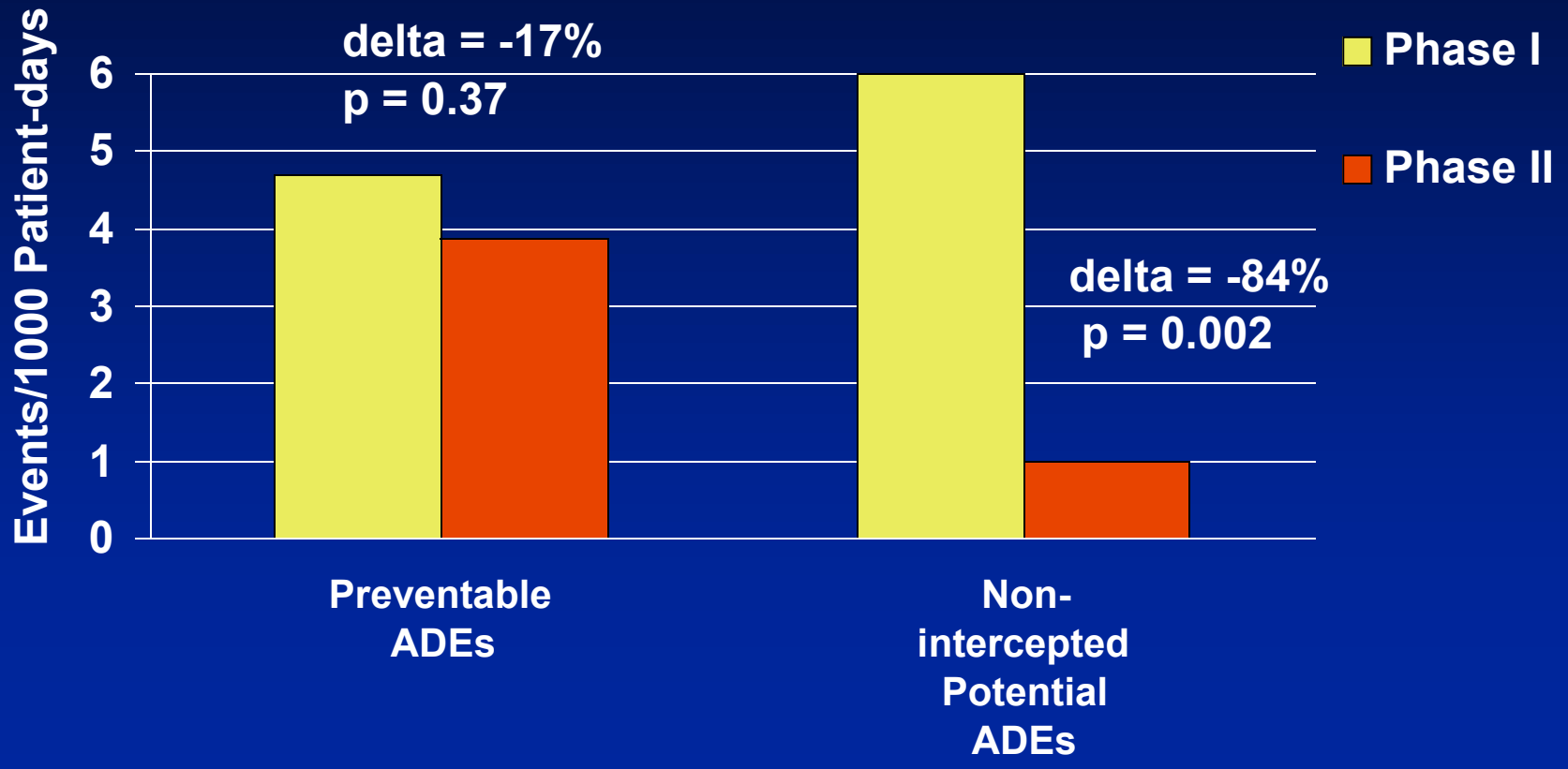
Impact of Computerized POE and a Team Intervention on Serious Medication Errors

- POE Intervention
  - All orders complete
  - Transcription minimized
  - Early checking including drug-allergy, drug-drug
- Team Intervention
  - Changing role of pharmacist
  - Computerized drip rate calculation program
  - Standardized labeling of bags, tubes and pumps
  - Implementing pharmacy communication log to facilitate communication between nursing and pharmacy

Comparison of Serious Medication Error and ADE Rates



Paired Comparison of Preventable ADEs and Non-intercepted Potential ADEs



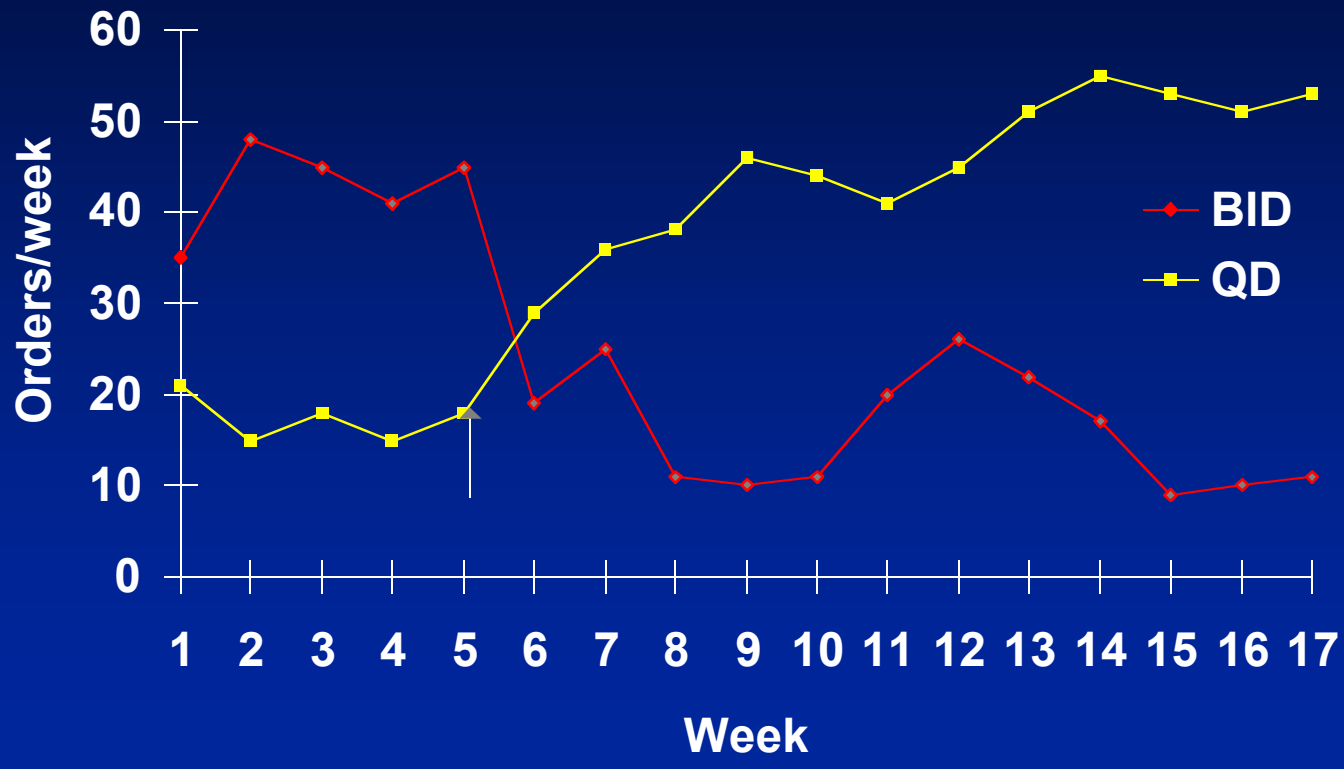
Study Conclusions

- Serious medication error rate fell by over half
- Potential ADE rate fell more than preventable ADE rate
- Additional evaluation of interventions like team interventions should be done
- Further reductions possible with additional improvements
  - System evaluated was missing many features

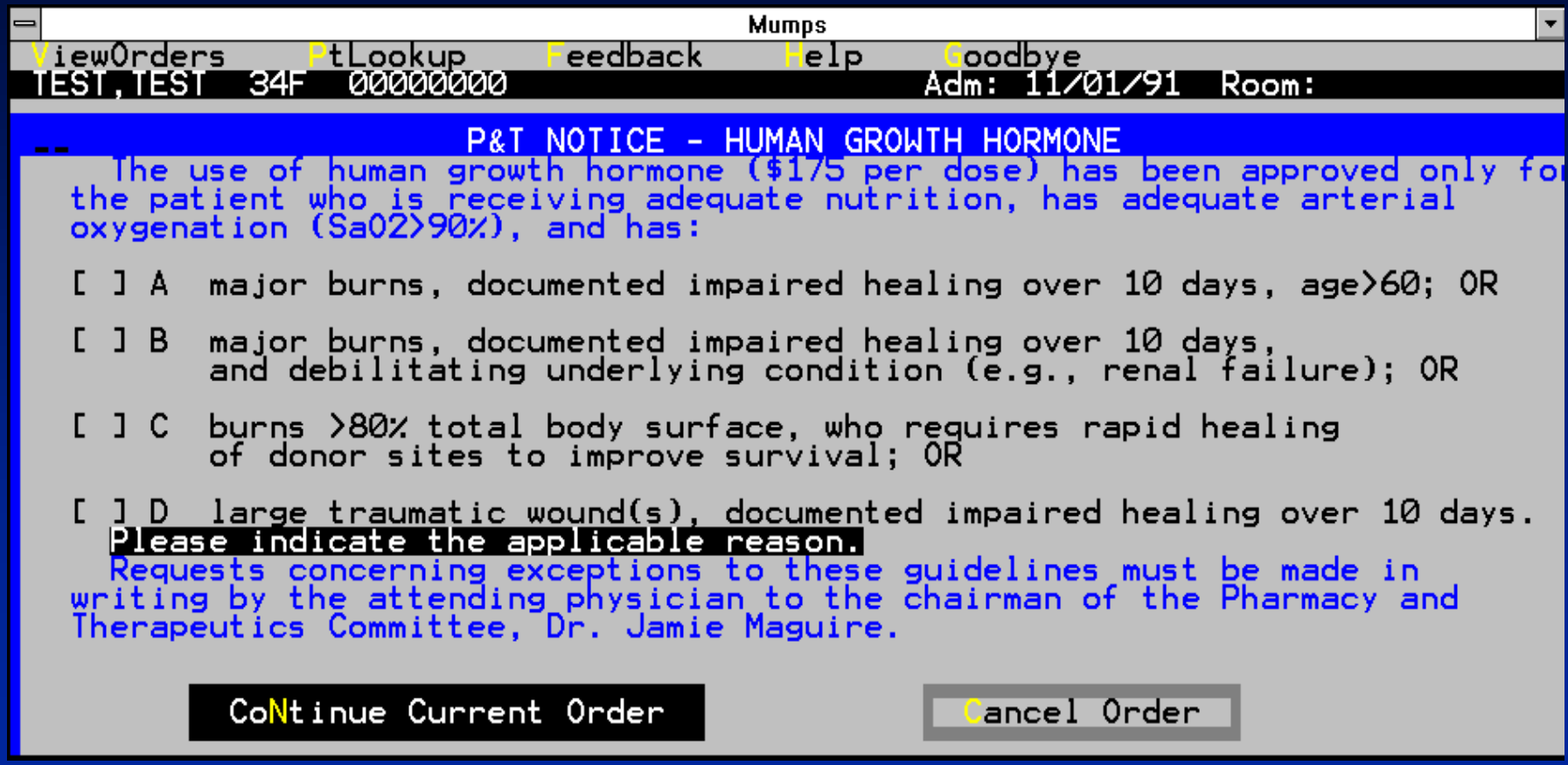
Reducing Drug Costs and Improving Use with Order Entry

- Types of useful suggestions
  - Drug interchange
  - Lower dose
  - Different route (IV-PO switches)
  - Guidelines for use

Effect of Changing Default Dosing Frequency for Ceftriaxone



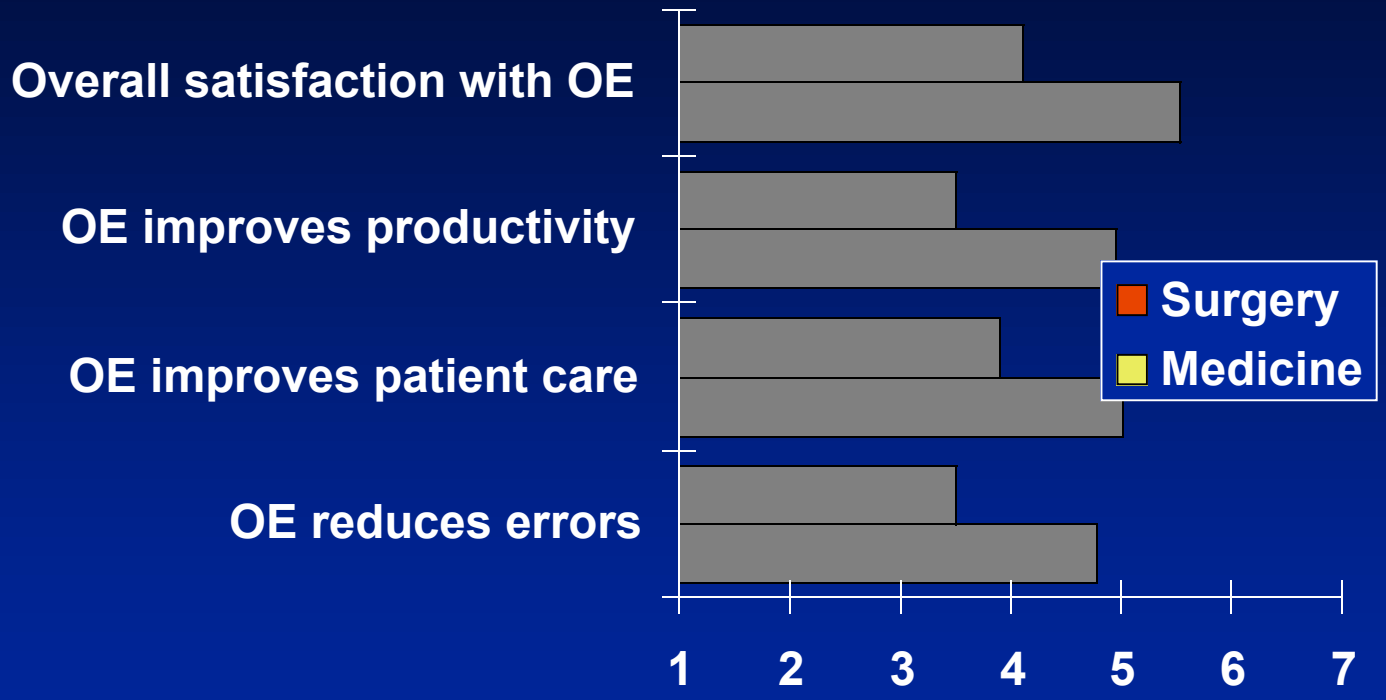
Guideline for Expensive Agent



Impact of Computer OE on Physician Time

- Order writing took twice as long on computer
  - Medical HOs 44 min/day, recovered half
  - Surgical HOs 73 min/day, no recovery
- Daily and one-time orders accounted for most of change, increasing 3-fold
- Sets of orders took half the time they did before order entry
- Interventions
  - Introduction of “Write 1”
  - Reorganization of screens to facilitate access to OE

HO Satisfaction with OE



Lee, *JAM IA*, 1996

Rough Cost-Benefit for POE

- **Costs:**
  - Development $1,000,000
  - Hardware $400,000
  - Maintenance $500,000/year
- **Benefits:**
  - Overall $5-10 million/year charges
  - Main savings relate to efficiencies re drugs, ADE prevention, and tests
  - Many other interventions coming on line all the time

Barriers to Physician Computer Order-Entry

- Cost
- Provider resistance to automation
- Inconsistency in availability of systems across different areas of practice (e.g. amb)
- Lack of voice activation for medication orders
- Tendency for hospitals to computerize business operations over clinical
- Design weaknesses in computer systems

Internet and Decision Support

- Helps by providing standard interface
- Can build standard apps with Web front end
  - Thin client helps so don't need superworkstations
- Cost reduced

Issues

- Security, confidentiality
- Standards
- Who controls data at end of day

Key Lessons

- Physicians are happy to change direction
  - Much less willing to stop after action started
- Respond well to quality-related suggestions
  - But even if low-yield utilization identified may proceed
- Satisfaction with these efforts good
- Success depends on integration with practice flow
- Developers must think speed, speed, speed...

Regulatory Developments

- HCFA is developing new rules
  - Considering mandating on-going computerized monitor
  - Initial regs set upper limit of 0 serious medication errors, are being redone
- MEDPAC (Medicare payment advisory commision) report suggests financial incentives for POE implementation
  - Idea is HCFA likely to mandate measurement
- FDA's post-marketing surveillance is limited, focussed narrowly on new signals
  - New approach would give data about rates

Medication System of the Future

- Providers write orders on computerized systems, get feedback
  - Face-to-face counter-detailing for complex problems
- Orders sent directly to pharmacy
  - Pharmacist review
- Simple orders filled using automation
  - Pharmacy fills complex orders manually
- Point-of-care delivery devices linked with order-entry systems dispense medications
  - Intravenous medications delivered by “smart” systems
- All drugs, patients, personnel bar-coded
  - Computerized MAR records what given, when

Conclusions

- Providers increasingly demanding IT
  - Immediate, individual feedback key
- Computerizing ordering including decision support can decrease costs, improve quality, by:
  - Providing structure, requiring fields
  - Pointing out redundancies
  - Suggesting alternatives
  - Identifying errors--both commission and omission
  - Emphasizing important abnormalities
  - Making guidelines accessible
- Most quality measurement will be done using IT with data collection *at time care is provided*

Reducing Error in Medicine

"I don't want to make the wrong mistake."

Yogi Berra